Advanced Fire Protection Deluge System

United States Air Force Research Laboratory (AFRL/MLQ), Tyndall AFB, Florida
Explosion Fire Protection

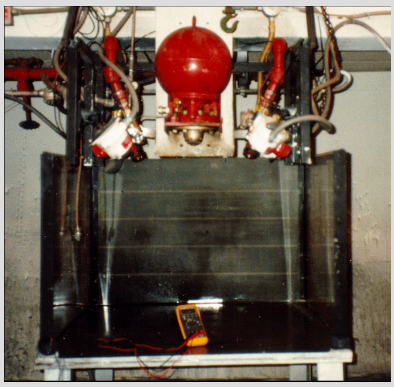
THE NEED

Energetic materials which burn or deflagrate pose a significant risk to munitions production, maintenance, and renovation operations. This is reflected by losses suffered by the US Army Armament Munitions and Chemical Command (now Industrial Operations Command) between 1988 and 1992. These costs totaled $9,500,000 and involved three deaths, nine serious injuries, and severe property damage. Contractors, working with similar materials, have since sustained additional losses.

In many ordnance facilities, fire detection and suppression systems have not fully kept up with advancements in new technologies. False alarms and slow activation times have occurred with serious impact on ordnance operations and on confidence in current systems.

THE APPROACH

This project develops and tests an ultra high-speed fire protection deluge system capable of detecting and extinguishing munitions fires in milliseconds (ms). A prototype system was built and set up in a test facility at Tyndall AFB, FL, which is capable of supporting explosive testing.



Detectors and 10 L sphere 36 in above test table

The Advanced Fire Protection Deluge System (AFPDS) uses commercially available high-speed optical flame detectors to trigger a solid state controller. The detectors use dual band IR and combination UV/IR technology.

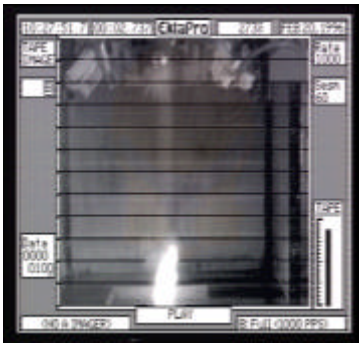
The units can be activated within 3 to 5 ms. This quick response is important in order to extinguish a flame before temperature and pressure causes a deflagration to become a detonation. The controller activates a spheroid high rate discharge extinguisher sending water to the threat at 170 ft/sec. Only a few gallons of water are necessary as the water is pressurized by nitrogen and is efficiently distributed in a fine mist. This delivery system eliminates any environmental problems and/or hazardous fumes.

Characteristic spectral emissions from the burning materials were measured. This data will be provided to the detector manufacturers to “fine tune” the detectors in order to further reduce response time and false alarms. False alarm sources were also tested and characterized.

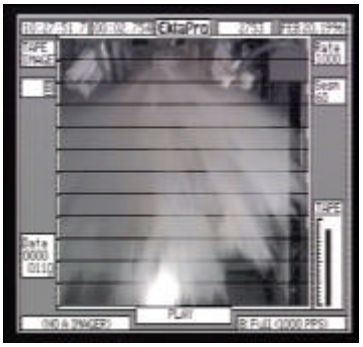
THE RESULTS

To date, in over 150 individual tests, the AFPDS has successfully detected and extinguished test fires from 17 materials including pyrotechnics, high explosives, and propellants. This is true for each of the four detectors used to activate the system (although some of the detectors are faster than others for a particular material burn). It is also noted that system response is slower for slow growing events compared to energetic events.

The AFPDS responds to an energetic material burn, such as M206, in 8 ms on average (6 ms detector response and 2 ms sphere discharge response). The current standard for ultra high-speed water suppression systems is NFPA 15 that requires 100 ms response time.



Detection



18 ms after detection

Each of the multi-spectrum detectors performed exceptionally well against false alarm sources. Two of the detectors did not alarm to any false alarm source over 3 feet away, including welding and the lighting of an acetylene torch.

Heat flux data is collected during testing to determine levels a worker is exposed to in a fire scenario. This data is compared to a standard for suppressive shields (MIL-STD-398) and the heat necessary to produce second degree burns to human skin. Even small, unsuppressed fires will frequently cause burns to exposed personnel. In the same situations, being protected by the AFPDS, the system will extinguish the flame before skin damage can occur and moreover meet MIL-STD-398 standards.

POINTS OF CONTACT

Doug Nelson
AFRL/MLQC
Ph: (850) 283-3742

Virgil Carr
ARA, Inc.
Ph: (850) 283-3732

Bob Rossi
Program Manager
Ph: (201) 724-5459
Funding provided
by AMSTA-AR-AL

Robert Loyd
Army Technical Advisor
AMSIO-DMS
Ph: (309) 782-2975